



Arrangement of optical elements in projection systems

- The invention relates to an arrangement of optical elements in projection systems, preferably in
- 5 projection modules having a changeable focal width such as for the imaging of tilt mirror matrices or for the imaging of reflective, i.e. transmissive, LCDs, whereby the optical elements fixed in place in mechanical holders are arranged so that they can be positioned on a common optical axis relative to one another.
- 10 Known arrangements having a changeable focal width that are used, for example, for the imaging of tilt mirror matrices differ essentially in the number of optical elements (lenses), their arrangement in the device as a whole, as well as the technical design data, in combination with the conditions that apply for the optical system. Such arrangements are described, for example, in U.S. 5644435 and DE 69328891.
- 15 Since it is desirable for the most frequent applications to change the size and the location of the image in order to thereby adapt the projection to the most varied spatial conditions, projection zoom systems are primarily used.
- 20 Such arrangements often use many lens elements and are therefore highly cost-intensive. Furthermore, different zoom movements have to be implemented. This has the result that the arrangements have a very complex structure, and therefore no small construction sizes, in terms of diameter and construction length, can be implemented.
- 25 Proceeding from these disadvantages, the invention is based on the task of further developing an arrangement of optical elements in projection systems so that both the construction lengths and the diameters of the overall arrangement can be reduced, with a minimized number of optical and mechanical elements, and thereby inexpensive production is possible.
- 30 This task is accomplished by means of an arrangement of the type described initially, according to the invention, in that for the purpose of accommodating the mounted optical elements only one common carrier element is provided that can be an integral part of the overall device (chassis) or that is configured as a releasable unit.
- 35 In this main carrier element, it is practical if only one focusing element and one zoom element are provided, i.e. only one element is used for focusing and only one element is used for changing the focal width, whereby it is practical if the system of the optical elements (lenses) is configured in such a manner that, during a zoom movement, the focusing state does not change or

changes only slightly. Furthermore, additional optical elements such as a field lens can be integrated rigidly into the main carrier element.

5 Depending on the application, it can prove to be practical to integrate the exposure device into the main carrier element, as well.

10 It is practical if pairs of threads are provided between the holders of the adjustment elements and the main carrier element for the purpose of the axial displacement of the focusing element and the zoom element, whereby rotational movements of the adjustment elements are converted into translational movements.

A possible embodiment consists of controlling the rotational movements of the focusing element and/or of the zoom element by way of guide cams.

15 The use of simple straight-line guides is also possible, whereby the translational displacement movements are directly initiated by means of introducing force onto the focusing element or the zoom element, respectively.

20 Depending on the application, the guides can be of the same type, i.e. configured either as pairs of threads between the main carrier element and the adjustment elements or as straight-line guides. But combinations are also possible, whereby either the focusing element is accommodated in the main carrier element by way of a pair of threads and the zoom element is accommodated by way of a straight-line guide, or vice-versa.

25 If the main carrier element is not a direct component of the overall piece of equipment, another advantageous embodiment of the arrangement consists of rigidly connecting the focusing element with the main carrier element and performing the axial displacement movement to change the focal width by way of a movement of the main carrier element itself. Analogously, this arrangement, i.e. this adjustment mechanism, would also be possible for the zoom element,
30 whereby the adjustment element not connected with the main carrier element, in each instance, does not follow the change in movement of the main carrier element.

35 In the production of the adjustment movements of the focusing element or zoom element, it can prove to be advantageous if the individual adjustment mechanisms are separated from one another in order, for example, to be able to make a separate correction of the focus in case of a change in the location of the zoom element and a related lack of focus of the image.

Furthermore, it is practical to arrange not only the focusing element and the zoom element but also the image-producing device into the main carrier element, as well.

5 The use of only one focusing element and only one zoom element with the simultaneous arrangement of the image-producing device in the common main carrier element makes it possible to design compact projection systems, i.e. optical modules having extremely small dimensions with regard to construction length and diameter, in a cost-effective manner. In the case of a zoom factor of > 1.1 , arrangements with constructions lengths of < 70 mm as well as front lens diameters of < 27 mm can be designed.

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All of the optical elements can be arranged in a sealed unit (module) so that a lens system that can be separated from the module is no longer required, as is known from the solutions according to the state of the art.

15 The arrangement according to the invention will be explained in greater detail below, using an example embodiment.

The related figure shows a main carrier element 1 in the form of a hollow cylinder in which a lens system, consisting of a focusing element 2 and a zoom element 3, is arranged in alignment with the optical axis 5. At the same time, an image-producing device 4 is located directly in the main carrier element 1.

20 For the purpose of the axial displacement of the lens system, the focusing element 2 is guided in the main carrier element 1 by way of the holder 6, and the zoom element 3 is guided by way of the holder 7. For this purpose, the outside walls of the holders 6 and 7 are in direct contact with the inside walls of the main carrier element 1. Furthermore, guides 8 and 9 are made in the walls of the main carrier element 1, into which shaped elements 10 and 11 of the holders 6 and 7 engage.

30 The figure shows the arrangement of the lens system in the main carrier element 1 only schematically. In this regard, the connection points between the holders 6 and 7 and the main carrier element 1 can be configured either as pairs of threads or as straight-line guides. In the case of pairs of threads, rotation movements of the holders 6 and 7 would be produced by way of the shaped elements 10 and 11, which movements would then be converted to axial displacement movements because of the pairs of threads. For this purpose, the guides 8 and 9 would have to be configured accordingly as a function of the rotation ranges to be implemented.

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Another possibility could be that translational displacement movements are initiated directly by way of the shaped elements 10 and 11, whereby the connections between the focusing element 2 or the zoom element 3 and the main carrier element 1 are configured as straight-line guides, and the guides 8 and 9 serve exclusively to guide the shaped elements 10 and 11 in the required adjustment range. In this context, the guides 8 and 9 can be configured either as straight
5 slits or in curve shape.

Depending on the application, it can also prove to be advantageous to do without the shaped elements 10 and 11 on the holders and to provide pins that are introduced into the holders 6
10 and 7 radially instead. This would particularly simplify the effort in assembling the arrangement.

The figure schematically shows only one specific variant of the arrangement according to the invention, whereby other optical modules that are possibly also arranged in the main carrier element 1 are not shown. The sequence of the arrangement of the optical elements, such as the
15 focusing element, the zoom element, the lenses and lens groups, depends on the application, in each instance.

Reference Symbol List

	1	Main carrier element
5	2	Focusing element
	3	Zoom element
	4	Image-producing device
	5	Optical axis
	6, 7	Holder
10	8, 9	Guide
	10, 11	Shaped element